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**Effect of low cost screen house on vegetable production in different agro-ecologies in Babati, District, Tanzania**

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Produced by World vegetable Center (Worldveg), Arusha Tanzania

  

**Introduction**

Vegetable production plays an important role in increasing household incomes and nutrition in sub-Saharan Africa (SSA). However, the subsector faces numerous constraints such as lack of reliable and sustainable markets, diminishing land sizes and weak market linkages, lack of cold storage and high post-harvest losses along the value chain and low adoption of production technologies among smallholder farmers. Protected cultivation techniques are emerging as viable option for increasing high valued crops such as tomatoes and sweet paper etc. Under Africa RISING low cost screen houses[[1]](#footnote-1) were tested with farmers in Babati District, Tanzania. Screen house provides an artificial crop environment through the use of soil covers and plant covers to control pests and climatic conditions. Screen house increase the yield and quality of vegetable crops and extend their production periods. This experiment protocol outlines the procedure used to evaluate the effect of screen house technology on vegetable production in different agro-ecologies in Babati, District, Tanzania.

**Objective of the study**

1. To assess effectiveness of screen house in promoting plant growth and increase yield of vegetable crops in different agro-ecologies

2. To assess the level of reduction of insect pests and use of insecticide under the screen house vs open field

**Treatment**

* Screen house
* Different agro-ecologies (Seloto vs Galapo villages) -They represent blocks in the experiment
* Two crops tested ( Sweet paper and Tomato)

**Experimental design**

The experiment follows Split plot design and will be done in rainy and repeated in dry season.

***Main plot****:* Screen house and Open

***Subplot:*** Crop (Tomato, Sweet pepper)

|  |
| --- |
|  |

**Location Agro-ecologies:**

Galapo and Seloto villages in Babati District, Tanzania (Experimental design is presented in Figure 1).

**Crops:**

Sweet paper (SW) and Tomato (T)

* Selected by farmers as it was proved to do well in their pilot plots for 2016 production season
* Both tomato and sweet pepper are in the same family (Solanaceae) they share same pest and diseases hence easy to manage. The difficulty of planting two varieties from different families simultaneously in the same plot and same season is that they can affect the other crop because pests from one family can affect the other crop in different family

**Variety:**

* Sweet pepper (**Yolo Wonder**)
* Tomato (**Tengeru 97**)

**Sample size (plant population in each screen house and Open)**

Random sampling and sample sizes will be determined using statistical methods; PLOT NUMBERS for treatments (sweet pepper and tomato) will be allocated randomly in each replication. The total of 108 plants of tomato per replication will be planted in 3 raised beds of 9 x 1 m in spacing of 50 x 60 and same plant population of tomato will be planted in control (open field) with the same plot size and spacing. Sweet pepper will be planted in a spacing of 45 x 60 cm in 3 raised beds of 9 x 1 m totals to 120 plat population in the screen house and the same plant population will be plated with the same plot size bed and spacing in the control plot (open field) as stipulated in crop production protocol (Annex 1).

**Plant population summary**

* Total plant population for *tomato* in all reps (screen house and open Field) = (108 x 2) x 4(reps) = **864 x 2 (Agro-ecologies) =1728**
* Total plant population for *Sweet pepper* in all reps (screen house and open Field) = (120 x 2) x 4(reps) = **960 x 2 (Agro-ecologies)=1920)**

**Replication:**

Four (4) replications will be randomized by fields, and farmsin 2 locations (4 in Galapo and 4 in Seloto village)in order to improves the estimate of the treatment effect and to provides estimate of error**,** the more times a treatment is duplicated the more likely it is the measurements reflect the effect of the treatment than natural variation in the field. Four replications are standard number in WorldVeg Center based research. The crops will be randomized in the screen house and open field (Control) in order to make sure that the order of treatments can’t be the same in each replication. Open field /control are where the treatment isn’t applied and this will give a basis for comparison.

**Field layout**

A plot will consists of improved practice and a control (farmer current normal practice) with length of 11 m and width of 7m per replication. Both treatments will need equal opportunity to produce the best they can in four REPLICATIONS /repetitions of each treatment, and assigned RANDOM plots (Figure 1)

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Galapo** | | | | | | | | | | |
| ***Open*** | ***Screen H*** |  | ***Screen H*** | ***Open*** |  | ***Open*** | ***Screen H*** |  | ***ScreenH*** | ***Open*** |
| *SW* | *Tomato* |  | *SW* | *SW* |  | *SW* | *Tomato* |  | *Tomato* | *SW* |
| *Tomato* | *SW* |  | *Tomato* | *Tomato* |  | *Tomato* | *SW* |  | *SW* | *Tomato* |
| **Rep 1** | |  | **Rep 2** | |  | **Rep 3** | |  | **Rep 4** | |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
| **Seloto** | | | | | | | | | | |
| ***ScreenH*** | ***Open*** |  | ***Open*** | ***ScreenH*** |  | ***Open*** | ***ScreenH*** |  | ***ScreenH*** | ***Open*** |
| *Tomato* | *SW* |  | *Tomato (* | *SW* |  | *SW* | *Tomato* |  | *Tomato* | *SW* |
| *SW* | *Tomato* |  | *SW* | *Tomato* |  | *Tomato* | *SW* |  | *SW* | *Tomato* |
| **Rep 5** | |  | **Rep 6** | |  | **Rep 7** | |  | **Rep 8** | |

Figure 1: Randomization of subplots crop per location: SW=Sweet pepper; ScreenH=Inside screen house.

**Data collection**

Research facilitator responsible for data collection in collaboration with farmers should keep a record of the basic as based on data collection form **(Annex 4).**The management practices employed, if they differ from what has been presented for each crop in the crop production protocol in one year season cropping calendar. **(Annex 1 & 2**). Record missing data for each trait per plot in each replication. Provide reasons for missing data: whether due to treatment or non-treatment effects. This information can be useful for explaining performance in different environment agro-ecologies. Properly calibrated weigh or yield monitor for harvest weights should be used.

**Reporting**

The formal reporting requirements will includes timely field trip reports, data collection reports, quarterly progress reports and annual report giving overview of both progress,summary of progress/achievements per output during the reporting period and plans for the next quarter. The report must highlight any impediments or constraints for implementation and ways used to address them.

**Statistical Analysis**

A combined ANOVA will be performed to test the significance of location and screen house main effects and their interaction. The variance s of the two locations will be tested for homogeneity to be able to do the combined ANOVA.

**Methodology for site and farmer facilitator selection criteria**

Meeting of farmers, extension agents, local leaders and research facilitators were organized in Seloto and Galapo agro-ecological villages. During the meeting, the researchers in collaboration with extension agents discussed with farmers the proposed research trial and questions arising about screen house trial, agrological requirements, treatments, research protocols overview and modality of operations. The role of the project facilitator of the trial, farmers and farmer trainer who will be responsible for the trial were cleanly discussed and in participatory way agreed to have a contract signed by both two partners **(Annex 3)** before start up the on farm research trial. From the discussion meeting with farmers the following were agreed regarding site and farmer selection criteria

**Site selection criteria**

* Reliable water availability for irrigation for two production season
* Based on pre-demarcated and developmental domains for sustainable intensification e.g. climate variability
* semi-arid low land - **Gallapo (1,300 m asl**)
* semi-humid up-land- **Seloto (1,500-1,700 m asl)**
* Site visibility ( access for people to see the plot or keep it ‘out of site for learning, management and security)
* Field topography- includes such conditions as flat land, good soil with good drainage and free from waterlogged. These characteristics can have a significant influence on crop production and management.
* Plot size – Availability of enough area for construction of the screen house (11 x 8 m) and same size land for open field
* Uniformity in soil type, fertility and s structure

**Farmer Trainer selection criteria**

* A good vegetable and maize innovative farmer working in Africa RISING project identified sites
* Have a good reputation in the community
* Own farm easily accessible.
* Farm families as farming their main occupation
* Women and youth are more encouraged (50%)
* Good motivation towards faming and long-term commitment
* Acceptable in the community
* Willing to work in a group and share knowledge and skills with the neighbors.
* Willing to participate demo trial (FFS) step by step sessions and train others for a period of two succession production seasons

**Annex 1: Tomato and sweet pepper production protocol**

This protocol contains significantly detail of the crop specific production procedures from nursery establishment to harvesting. The aim of this guide is to familiarize tomato and sweet pepper growers with good production and crop management techniques for raising healthy vegetable crops and to promote adoption of Good Agronomic Practices (GAP) with emphasis on Integrated Pest Management Practices (IPM) as the way to control pests by bring together different management practices (cultural and biological) without relying solely on pesticides.

**General aspects**

1. **Classification**

Scientific name: Tomato- *Lycoperscon esculentum*

Sweet Pepper - *Capsicum Annum*

1. **Cultivars/Variety :** Sweet pepper (Yolo wonder)

Tomato(Tanya **–** determinate ) - **determinate** variety grows to a genetically pre-determined size and then stops while **indeterminate type** continually produce new stems, leaves, and fruits at all stages of development throughout its life until the plant dies

The crops and variety for the trial were selected by farmers since were proved to do well in AR selected sites as it was experienced by farmers in 2016 pilot fields.

1. **Climatic Requirements**
   1. **Temperature** average daily mean of 20°C - 24°C for tomato. Sweet pepper grow well in climate ranging from war to hot, very low temperature result to stunted growth(Below 10 °C and excessive temperature hinder the fruiting process.
   2. **Soil**: Tomato-Well managed Sandy loams and clays loam soils rich in organic matter with a PH value of 6-7;
      * 1. Pepper- Light loamy non acidic fertile, PH range 5.5-6
   3. **Rainfall:** Tomato due well in medium between 700-1300 mm per annum while Sweet pepper thrive well in areas of 800-1200mm per annum

**Cultivation practices**

1. **Propagation:**

By seeds by use of health seedlings

Seed rate: Tomato (100-125gm/acre)

Sweet pepper (300-350/Ha)

**1.1 Establishment of healthy seedlings**

Appropriate healthy selected crop varieties recently produced seeds from a reliable source will be selected to ensure enough seedlings are available. Depending on the seed cost and germination rate, it is recommended to plant 15-100% additional seeds to ensure enough seedlings are ready for planting at the optimal time. Plastic trays filled with healthy soil medium (peat moss) will be plated with selected good elite variety of sweet pepper and tomato in different trays per crop. 2 seeds will be sown per cell, covered with fine potting mixture; water gently with a fine sprinkler and trays will be placed on benches in a screen house. When 1-2 true leaves appear, thin out excess seedlings and keep only one seedling per cell per crop.

**Fertilization:** Use of poly-feed starter 10 g in 10-15 liter of water will be applied between the 9th and 11th days (without touching the plants) after seed emergence – followed by a daily dose of water. During the seedling stage (between 11 and 21 days) – fertilizer will be applied after every 3 days with water and subsequently water only applied every other 4 days in that sequence until transplanting.

Around 7-10 days after thinning, if the seedlings seem thin or the leaves turn a pale yellow-green color, especially on the older foliage, apply one of the following treatments once to the seedlings:

* **Option 1)** 0.5% ammonium sulfate solution (5 g ammonium sulfate dissolved in 1 liter of water)
* **Option 2)** 0.25% urea solution (2.5 g urea dissolved in 1 liter of water)

Apply again one day before transplanting. Do not over-apply nitrogen or the plants will grow too tall and thin. Monitor seedling growth; if the seedlings grow too rapidly before transplanting, apply less fertilizer.

**Hardening:** When seedlings have 4-5 true leaves (around 20-25 days after sowing for tomato and 25-30 days for sweet pepper), harden the seedlings by slightly reducing the water supply. Around 6-9 days before transplanting, slightly reduce watering, remove the netting and expose the seedlings to strong sunlight so that they will be stocky and sturdy (Fig. 2). ***Inoculation*** of seedlings to prevent/ minimize effect of fungal infection in the field will be done before transplanting. Thoroughly water the seedlings 12-14 hours before transplanting them to the field. Good health seedlings will have the following features; at least 4-5 true leaves, around 12-15 cm tall, short internodes length, vigorous and stocky, no pest & disease symptom and no flower buds or flowers)



**Note:** Raising seedlings in separate pots/containers such as plastic trays provide adequate nutrients and growing medium for healthy root development and seedling growth. Seedlings rose in individual containers normally have a 100% establishment rate in the field since they are transplanted with the medium-root block (Fig. 2). This prevents injury to the roots and transplanting shock to the seedlings

Figure 2 Tomato healthy seedlings raised in plastic trays ready for transplanting

1. **Land preparation**

**Open field and screen house:** Clear all bushes and weeds. Plough and harrow the field to fine tilth and incorporate well decomposed manure/compost into beds/ridges 2 tins (20 liters) in every 1x1m bed prior to planting and mix well into soil

1. **Planting/Transplanting:**

One month after sowing or when seedlings have at least 4-5 true leaves. Healthy and vigorously seedlings still with some soil attached with roots will be transplanted to the well prepared field. The best time for transplanting is during the cloudy day or late in the evening. Unlike most plants, tomatoes do better if planted deeper than they were grown in containers. Set them in the ground so that the soil level is just below the lowest leaves. Roots will form along the buried stem, establishing a stronger root system.

1. **Spacing**:

**Tomato**: 50 cm between plants (within the row) and 60 cm between rows within the 20cm raised bed in each treatment (Screen house and open field)

**Sweet pepper**: 45 cm between plants (within the row) and 60 cm between rows within the 20cm raised beds. Each bed for both tomato and sweet pepper should measure 9m long and 1m wide

1. **Fertilization:**

**Tomato**: Rotten animal manure, or compost at rate of 20-30 tons/hectare) before transplanting; the plants will be fertilized with 120 kg/Ha of NPK (complete fertilizer) and 100 N/Ha. All of NPK should be applied as basal application during transplanting as side – dress one week after transplanting. Urea application should be divided in two splits, with the first application applied together with the first NPK application during or one week after transplanting and the second application three to four weeks after the first application or when formation fruit begins.

**Sweet pepper:** Decomposed animal manure or compost at a rate of 15-20 tons/hectare) should incorporate in the soil before transplanting. The plants should then be fertilized with 400/Ha of NPK (20:10:10) and 120/Ha of Urea. 200/Ha of NPK should be applied as a basal application during transplanting or as side- dress one week after transplanting. The second application of 200kg/Ha should be applied four weeks after the first application. Urea application should be divided in three splits , with the first application applied together with the first NPK during one week after transplanting, the second application three weeks after the first or when fruit formation begins, and the third application another three weeks after the second application.

1. **Mulching:**

Mulch is simply a covering over the soil that keeps moisture in, blocks weeds and protects low-growing crops such as tomato from resting on the ground and developing rot. Grass of Plastic mulch best laid over bear soil only 2 inches (5 cm) to no more than 3 inches (7.6 cm) deep around tomato plants; thicker layer than that, have risk of reducing oxygen to the roots

1. **Irrigation:** Keep soil evenly moist to prevent blossom end rot. This can also help prevent cracking when fruit absorbs water too fast after heavy rain following dry conditions. Irrigation will be done by use of watering can in planting holes as the beds will be covered by plastic mulch.
2. **Staking**

Wooden pole stakes (2-3m long with 1-1.5’’diameter)” are recommended to provide adequate support. **Insert stake into the ground** about 3-6 inches from the base of the tomato seedling, just after planting (to prevent root damage). Place stake on north side of plant so stake won’t shade the tomato. **Wait to tie plants to stakes** until first flowers appear. This encourages the main stem to grow strong. **Tie branches to the stake for support.** Use a length of string, or sisal rope, loop the tie from the stake, around the stem or extended branch, and back to the stake forming a figure-8 with the stem in one loop and the stake in the other. This gives the stem room to expand without being constricted. Make sure the tie allows some “give” room for the plant so branches can get larger as the season progresses. Tie branches to the stake opposite blossoms so that when fruit grows, it is not trapped between the stake and the tie. **Check plants regularly** – even daily – for new growth. Continue to tie center stem and branches every 18-24.” As an alternative to using individual stakes, grow several plants in a row between heavy-duty stakes or posts spaced about 1.5-2 m apart, and use twine to weave in and out around posts and plants.

1. **Pruning**

Prune **tomatoes** to one or two vigorous stems by snapping off "suckers" (stems growing from where leaf stems meet the main stem) diseased and malformed parts to keep the crop at manageable size. Pruning can be at any time, when it is small or when it has grown large. A tomato plant can first be pruned when it is just **12** to **18** inches tall. Prune so that leave do not shade other leaves. (Sunshine must hit leaves for photosynthesis to occur. Prune to allow air circulation to the center of the plant. Air circulation helps deter diseases and insects. Avoid pruning away leaves above fruit clusters; these leaves protect fruit and stems below from sunburn.

**Sweet pepper:** Depending on fruit size required prune to maintain 2-4 stems per plant

1. **Weeding**

Effective weed management in tomatoes involves crop *rotation practices*, cultivation, proper *field preparation* and sanitation and irrigation management. When combined with good agronomic practices, can control many of the weed species that are found in tomato fields; identification and knowledge of target weeds (Monitoring) is essential for weed management in tomatoes because it influences management decisions. Conduct weed surveys on each field at least twice a year: the *first after crop planting but before weeding* and the *second just before harvesting*. Record observations on a monitoring form; When plastic mulch is applaud it is advised to carefully removal weeds around the plat stem to prevent plat root injury.

1. **Pest and diseases management**

Control on different pests and diseases during crop growing will follow integrated **pest management (IPM)** as a pest management approach that uses all available pest control methods which are in harmony with the environment, suitable, simple to apply and affordable to maintain to apply but not limited to the judicious use of pesticides, to optimize a crop’s ability to resist the pest with the least hazard to man and the environment. Integration includes mixing different methods together to get the best-bet alternative. These include:

***Cultural methods***: include crop rotation, soil tillage, use of trap crops, and change in planting or harvesting time, intercropping with other crops or with varieties that repel pests

***Mechanical and physical methods***: techniques such as collecting pests with traps, physical barriers, sound barriers or screens.

**Biological control:** include the uses of microbial pathogens (e.g., bacterium, fungus) that generally attack a specific pest and the release of predators and parasitoids to control insect pests

***Chemical methods*:** where chemicals are used to kill the pests but kept as the last option

IPM must continually change to meet pest management challenges.It is very usual for farmers to experience an outbreak of new pests, new traces/strains of pests, weed species or shifts and pesticide resistance. The approach advocates for and teaches beneficiaries to go by the principle of a combination of avoidance of pest incidence, proper timing, on-going process monitoring of pest and disease thresholds**,** tolerance of some pests and damage threshold situations and sets thresholds for acceptable damage.

**Recommendations for minimizing residues**

*Avoid pesticide use by:*

* Good husbandry, including irrigation and nutrition.
* Good site hygiene.
* Use of clean plant material and resistant cultivars.
* Use of bio control agents for pest control, and when available, disease control.
* Use of environmental manipulation.
* use of spray materials with physical modes of action (non-pesticides) where appropriate

*Minimize pesticide use by:*

* Maintaining strict routines of crop monitoring to ensure that any remedial action is taken at the first opportunity for great effect with least sprays.
* Ensuring adequate training in the recognition of pests, diseases and bio-control agents by all staff, especially crop workers, to ensure rapid and appropriate response.
* Ensuring adequate training in nursery environment control, for disease suppression especially.
* Maintaining and calibrating sprayers with care to ensure efficient spray application. Studies on the vertical boom sprayers used in tomato crops indicate poor and uneven application in some cases. This results in under dosing some parts of the plant, with a consequent risk of poor control and the need for repeat sprays, and over-dosing of other parts with a risk of exceeding pest infection. Factors such as spray nozzle uniformity along the boom, nozzle spray angle and spray volume are all important.
* Ensuring correct dose rate as this may vary according to the target pest and whether on or off label.
* Choosing any pesticides with careful attention to possible side effects on bio control agents

1. **Field hygiene/sanitation**

Proper sanitation in both screen house and open field should be maintained throughout cropping period.

Large proportions of tomatoes are eaten raw or half cooked. The operations linked to production in the field must reduce to a minimum the potential risks for *consumer* and *environmental health* that may arise from the contamination of vegetables.

1. **Harvesting**

**Tomato:** Harvesting is done in 2 months after transplanting and continues up to 6-8 weeks (1-2 moths). For canning the fruit should be ripe but for fresh market should be slightly under ripe.

**Sweet pepper:** The mature fruits are ready for harvest, 60 days after transplanting, the harvesting will continue for 2 months or more.

1. **Yield:**

**Tomato**: Under good management- **open field** (50-100 tons/Ha); **Screen house** (200-300tons/Ha)

**Sweet pepper**: Under good management – **Open field** (25-30tons/Ha); **Screen house** (100-120tons/Ha)

1. **Record keeping:**

Reliable information recorded includes sowing and planting dates, Varieties grown crop yield, amount sold, consumed, inputs, technologies, cost benefit analysis among others.

1. **Reviewing results**

Existing records and practices areexamined critically by the farmers and research facilitators in order to improve and compare the overall vegetable in different agro-logical locations.

Cost Benefit Analysis (CBA) will be carried out for each crop to assess the impact of selected treatments agro ecologies, Screen house, two crops tested (Sweet pepper and tomato) and analyzing the economic performance for improving smallholder livelihoods in Babati District Tanzania over two production seasons.

**ANNEX 2: Tomato (t) and Sweet pepper (sw) production schedule (open field and screen house) 2017**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Jan | Feb | Mar | Apr | May | Jun | July | Aug | Sept | Nov | Oct | Dec | Comments |
| Farmer and site selection , set up screen houses | T  SW | T  SW |  |  |  |  |  |  |  |  |  |  |  |
| Establishment of Health seedlings |  | T  SW |  |  |  |  |  |  |  |  |  |  |  |
| Land preparation |  | T  SW | T  SW |  |  |  |  |  |  |  |  |  |  |
| Transplanting |  |  | T  SW |  |  |  |  |  |  |  |  |  |  |
| Mulching |  |  | SW  T |  |  |  |  |  |  |  |  |  |  |
| Fertilization |  | T  SW | T  SW | T  SW | T  SW |  |  |  |  |  |  |  |  |
| Irrigation |  | T  SW | T  SW | T  SW | T  SW | T  SW | T  SW |  |  |  |  |  |  |
| Pruning |  |  | T  SW | T  SW |  |  |  |  |  |  |  |  |  |
| Stalking |  | T | T | T | T |  |  |  |  |  |  |  |  |
| IPM & GAP  (FfS) |  | T  SW | T  SW | T  SW | T  SW | T  SW | T  SW |  |  |  |  |  |  |
| Weed control |  |  | T  SW | T  SW | T  SW |  |  |  |  |  |  |  |  |
| Harvesting |  |  |  |  | SW | T  SW | T  SW | T  SW |  |  |  |  |  |
| Data collection and Management |  | T  SW | T  SW | T  SW | T  SW | T  SW | T  SW | T  SW |  |  |  |  |  |
| Follow up visits and monitoring |  | T  SW | T  SW | T  SW | T  SW | T  SW | T  SW | T  SW |  |  |  |  |  |
| Data Analysis |  |  |  |  |  |  | T  SW | T  SW |  |  |  |  |  |
| Feedback/ Data sharing |  |  |  |  |  |  |  | T  SW | T  SW |  |  |  |  |
| Reporting/feed back from the field |  | T  SW | T  SW | T  SW | T  SW | T  SW | T  SW | T  SW | T  SW |  |  |  |  |

**ANNEX 3: Africa RISING farmer group agreement**

1. This agreement is jointly entered between Africa RISING Vegetable Theme and the farmer group known by the following name:

Farmer group name: -------------------------------------------------

Registration Number: -------------------------------------------------

Village: -------------------------------------------------

District: --------------------------------------------------

1. This agreement has been entered in voluntary basis without any coercion and is for establishment and management of low cost screen house activities so as to determine its effect on vegetable production in different agro-ecologies in Babati, District, using the farmer on farm experimental trials as Farmer Field School (FFS) as training Extension methodology. The group members are expected to implement in their farm what they have learn in the trial host farm and share the knowledge and skills to their neighbors and other farmers.
2. This agreement has the following conditions;
3. The group has the following responsibilities
4. Provide land (12m x 8m) x 2 plot to start up and conduct the experiment trial (screen house & open field)
5. Use the area/plot located for research trial for agreed research experiment trial activities only
6. Land plot should be available for the screen house for at least 2 years
7. Pilot farmer together with group members will maintain the screen house (watering, weeding, harvesting, security
8. Collect data (date of first flowering, yield data) – data sheet will be provided
9. Keep record register of farmer group members and other farmer trained by research trial host farmer
10. In participatory way agreed with group members on how the crops harvested from the research trial will be shared within the group members.
11. Play the key role in timely data collection regarding the research trial based on data collection booklet provided to research trial host farmer
12. Graduate after successfully completing research trial activities through FFS training with more than 75% based on register book.
13. Africa RISING Project Facilitators has the following responsibilities;
14. Provide materials and facilitation in screen house construction in selected AR sites for the first trial
15. Provide farm inputs (seeds, fertilizer, watering can) for the first trial
16. Capacity building to farmer to on various GAPs including IPM flagship technologies regarding screen house experiment through Farmer field School (FFS) for the first trial
17. Follow up visits to monitor group performance and provide necessary backstopping
18. Data collection and management and share feedback with farmers regarding the research trial
19. Shall stop further assistance if the group deviate from the agreed activates.

**Signed**

|  |  |
| --- | --- |
| ON BEHALF OF THE FARMER | ON BEHALF OF THE AFRICA RISING PROJECT |
| Name of the Chair person: | Name of the field Coodinator: |
| Signature: | Signature: |
| Date: | Date: |

**Annex 4: Data collection form**

4a) Labor cost data sheet

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Labor input | Labor input **in hours** per week on **screen-house plots** | | | | | | | | | | | | | | | |
|  | Week 1 | Week 2 | Week 3 | Week 4 | Week 5 | Week 6 | Week 7 | Week 8 | Week 9 | Week 10 | Week 11 | Week 12 | Week 13 | Week 14 | Week 15 |
| Land preparation |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Transplanting |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Mulching |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Irrigation |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Plant protection | Data recorder: survey of the plots | data entry &record | Effect Data collection |  |  |  |  |  |  |  |  |  |  |  |  |
| Fertilization |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Staking |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Others |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Labor input | Labor input **in hours** per week on **outside plots** | | | | | | | | | | | | | | | |
|  | Week 1 | Week 2 | Week 3 | Week 4 | Week 5 | Week 6 | Week 7 | Week 8 | Week 9 | Week 10 | Week 11 | Week 12 | Week 13 | Week 14 | Week 15 |
| Land preparation |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Transplanting |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Mulching |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Irrigation |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Plant protection |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Fertilization |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Staking |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Others |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

**4b) Harvest data collection**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Date** | **Unit** | **Harvests** | | | | | | | | | |
|  |  |  | **Harvest 1** | **Harvest 2** | **Harvest 3** | **Harvest 4** | **Harvest 5** | **Harvest 6** | **Harvest 7** | **Harvest 8** | **Harvest 9** |
| **Tengeru 2010 (in screen house)** | | | | | | | | | | | | |
| Date of first flowering |  |  |  |  |  |  |  |  |  |  |  |
| Maturity date (at least one red tomato) |  |  |  |  |  |  |  |  |  |  |  |
| Date of last harvest |  |  |  |  |  |  |  |  |  |  |  |
| Date of harvest |  |  |  |  |  |  |  |  |  |  |  |
| **Total yield** per variety |  | Kg/variety |  |  |  |  |  |  |  |  |  |
| **Total marketable** yield |  | Kg/variety |  |  |  |  |  |  |  |  |  |
| Price obtained per kg marketable yield |  | TSH/kg |  |  |  |  |  |  |  |  |  |
| Number of plants harvested per variety |  | No. of plants |  |  |  |  |  |  |  |  |  |
|  | **Date** | **Unit** | **Harvests** | | | | | | | | | |
|  |  |  | **Harvest 1** | **Harvest 2** | **Harvest 3** | **Harvest 4** | **Harvest 5** | **Harvest 6** | **Harvest 7** | **Harvest 8** | **Harvest 9** |
| **Tanya (in screen house)** | | | | | | | | | | | | |
| Date of first flowering |  |  |  |  |  |  |  |  |  |  |  |
| Maturity date (at least one red tomato) |  |  |  |  |  |  |  |  |  |  |  |
| Date of last harvest |  |  |  |  |  |  |  |  |  |  |  |
| Date of harvest |  |  |  |  |  |  |  |  |  |  |  |
| **Total yield** per variety |  | Kg/variety |  |  |  |  |  |  |  |  |  |
| **Total marketable** yield |  | Kg/variety |  |  |  |  |  |  |  |  |  |
| Price obtained per kg marketable yield |  | TSH/kg |  |  |  |  |  |  |  |  |  |
| Number of plants harvested per variety |  | No. of plants |  |  |  |  |  |  |  |  |  |
|  | **Date** | **Unit** | **Harvests** | | | | | | | | | |
|  |  |  | **Harvest 1** | **Harvest 2** | **Harvest 3** | **Harvest 4** | **Harvest 5** | **Harvest 6** | **Harvest 7** | **Harvest 8** | **Harvest 9** |
| **Yolo Wonder (in screen house)** | | | | | | | | | | | | |
| Date of first flowering |  |  |  |  |  |  |  |  |  |  |  |
| Maturity date (first market. bell pepper) |  |  |  |  |  |  |  |  |  |  |  |
| Date of last harvest |  |  |  |  |  |  |  |  |  |  |  |
| Date of harvest |  |  |  |  |  |  |  |  |  |  |  |
| **Total yield** per variety |  | Kg/variety |  |  |  |  |  |  |  |  |  |
| **Total marketable** yield |  | Kg/variety |  |  |  |  |  |  |  |  |  |
| Price obtained per kg marketable yield |  | TSH/kg |  |  |  |  |  |  |  |  |  |
| Number of plants harvested per variety |  | No. of plants |  |  |  |  |  |  |  |  |  |
|  | **Date** | **Unit** | **Harvests** | | | | | | | | | |
|  |  |  | **Harvest 1** | **Harvest 2** | **Harvest 3** | **Harvest 4** | **Harvest 5** | **Harvest 6** | **Harvest 7** | **Harvest 8** | **Harvest 9** |
| **Tengeru 2010 (outside plot)** | | | | | | | | | | | | |
| Date of first flowering |  |  |  |  |  |  |  |  |  |  |  |
| Maturity date (at least one red tomato) |  |  |  |  |  |  |  |  |  |  |  |
| Date of last harvest |  |  |  |  |  |  |  |  |  |  |  |
| Date of harvest |  |  |  |  |  |  |  |  |  |  |  |
| **Total yield** per variety |  | Kg/variety |  |  |  |  |  |  |  |  |  |
| **Total marketable** yield |  | Kg/variety |  |  |  |  |  |  |  |  |  |
| Price obtained per kg marketable yield |  | TSH/kg |  |  |  |  |  |  |  |  |  |
| Number of plants harvested per variety |  | No. of plants |  |  |  |  |  |  |  |  |  |
|  | **Date** | **Unit** | **Harvests** | | | | | | | | | |
|  |  |  | **Harvest 1** | **Harvest 2** | **Harvest 3** | **Harvest 4** | **Harvest 5** | **Harvest 6** | **Harvest 7** | **Harvest 8** | **Harvest 9** |
| **Tanya (outside plot)** | | | | | | | | | | | | |
| Date of first flowering |  |  |  |  |  |  |  |  |  |  |  |
| Maturity date (at least one red tomato) |  |  |  |  |  |  |  |  |  |  |  |
| Date of last harvest |  |  |  |  |  |  |  |  |  |  |  |
| Date of harvest |  |  |  |  |  |  |  |  |  |  |  |
| **Total yield** per variety |  | Kg/variety |  |  |  |  |  |  |  |  |  |
| **Total marketable** yield |  | Kg/variety |  |  |  |  |  |  |  |  |  |
| Price obtained per kg marketable yield |  | TSH/kg |  |  |  |  |  |  |  |  |  |
| Number of plants harvested per variety |  | No. of plants |  |  |  |  |  |  |  |  |  |
|  | **Date** | **Unit** | **Harvests** | | | | | | | | | |
|  |  |  | **Harvest 1** | **Harvest 2** | **Harvest 3** | **Harvest 4** | **Harvest 5** | **Harvest 6** | **Harvest 7** | **Harvest 8** | **Harvest 9** |
| **Yolo Wonder (outside plot)** | | | | | | | | | | | | |
| Date of first flowering |  |  |  |  |  |  |  |  |  |  |  |
| Maturity date (first market. bell pepper) |  |  |  |  |  |  |  |  |  |  |  |
| Date of last harvest |  |  |  |  |  |  |  |  |  |  |  |
| Date of harvest |  |  |  |  |  |  |  |  |  |  |  |
| **Total yield** per variety |  | Kg/variety |  |  |  |  |  |  |  |  |  |
| **Total marketable** yield |  | Kg/variety |  |  |  |  |  |  |  |  |  |
| Price obtained per kg marketable yield |  | TSH/kg |  |  |  |  |  |  |  |  |  |
| Number of plants harvested per variety |  | No. of plants |  |  |  |  |  |  |  |  |  |

1. C) Pre-harvest data collection:

3. To evaluate the retention of water and minerals under the screen house vs open field production

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Data to be collected** | **Date** | **Unit** | **Harvests** | | | | | | | | |
|  |  |  | **Week 1** | **Week 2** | **Week 3** | **Week 4** | **Week 5** | **Week 6** | **Week 7** | **Week 8** | **Week 9** |
| **Tengeru 2010 (outside plot)** | | | | | | | | | | | |
| Plant height | 2nd week after transplanting | Cm above soil |  |  |  |  |  |  |  |  |  |
| Plant width | 2nd week after transplanting | Cm(expanded area) |  |  |  |  |  |  |  |  |  |
| Number of leaves per plants | 2nd week after transplanting | No. of leaves |  |  |  |  |  |  |  |  |  |
| Leaf size per plant | 2nd week after transplanting | Cm(expanded area)m |  |  |  |  |  |  |  |  |  |
| Number of damaged leaves per plant | 2nd week after transplanting | Holes, mines,bird cuts |  |  |  |  |  |  |  |  |  |
| Rate of disease transmission | 3rd week after transplanting | Number of infected leaves/plants |  |  |  |  |  |  |  |  |  |
| Number of damaged fruit  Number of fruits eaten by birds | Fruit maturity | No. of fruits |  |  |  |  |  |  |  |  |  |
| Number of plants harvested per variety | Harvesting | No. of plants |  |  |  |  |  |  |  |  |  |
| % marketable yield |  | Good/total yield |  |  |  |  |  |  |  |  |  |

Pest and disease management and fertilization *outside screen-house*

|  |  |  |  |
| --- | --- | --- | --- |
| Date | Chemicals open field | Rate applied open field | Time spent per plot |
| 1st week | Ridomil & antifungals for control of dumping off | Same rate with screen house (antifungal) |  |
| 2nd week depending on insect detected | Insecticides-varies |  |  |
| 2nd week depending on insect detected | Nimbercidine |  |  |
| Any stage | Power | Both inside and outside for powdery mild dew |  |

Pest and disease management and fertilization *inside plot*

|  |  |  |  |
| --- | --- | --- | --- |
| Date | Chemical/fertilizer type applied on outside plot | Rate applied per inside plot | Time spent per plot |
| 1st week | Ridomil & antifungals | Same rate with inside (antifungal) |  |
| 2nd week depending on insect detected | Wiltigo& biopesticides | Not required (assess cost ) |  |
| 2nd week depending on insect detected | Nimbercidine | Not required (assess cost ) |  |

**Insect pests to be monitored (From 1st week to maturity):**

*1. Tuta absoluta*

*2. Lyriomyza sativa*

*3. Bemisia tabaci*

*4. Aphis gossypii*

**Plant diseases**

1. Damping off (first 2 weeks after transplanting)

2. Fuzzy grey mold (from 4th week after transplanting)

3. Early bright/leaf spot (3rd week after transplanting)

4. Stem rot (from first week after transplanting)

Parameters to be recorded:

A. Vegetative data (from second week after transplanting):

1. Plant height

2. Plant width

3. Leaf width

4. Leaf height

5. Number of matured fruits/plant

6. Weight of matured fruits/plant

B. Pest management data (From first week after transplanting)

1. Number of insect species in and out net house

2. Number of damaged leaves /plant

3. Number of caterpillar or nymph/plant

4. Number of damaged fruits/plant

5. Weight of damaged fruits/plant

6. Percentage of marketable fruits /plot

7. Percentage of damaged fruits per plot

1. The design of the screen house was designed together with A to Z textiles in Arusha. [↑](#footnote-ref-1)